Volume 32 September, 1946 *Number 9*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

THE STRIP STEEL MILL

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICATION RECOMMENDATIONS FOR STEEL MILL EQUIPMENT

POWER EQUIPMENT

Blowing Engines	
Steam Cylinders	
Pressures above 150 lbs.	Texaco 650T Cylinder Oil
Pressures below 150 lbs.	Texaco Pinnacle Cylinder Oil
Air Cylinders or Tubs	Texaco Pelican Oil or Texaco Aries Oil
Air Compressors	Texaco Alcaid or Algol Oil
Electric Motor Bearings	
Oil Lubricated	Texaco Regal Oils (R&O)
Grease Lubricated	Texaco Regal Starfak
Steam Turbines	
Direct Connected	
Bearings and Governor Mechanisms	Texaco Regal Oil A (R&O) or B (R&O)
Geared Turbines	
Gears and Bearings	Texaco Regal Oil C (R&O) or E (R&O)

SOAKING PITS AND INGOT BUGGIES

Open Gears	Texaco Crater No. 5X or No. 10X
Enclosed Gears (Bath Lub.)	Texaco Meropa Lubricants
Worm Gears on Pit Covers and Buggies	Texaco Meropa Lubricants
Pit Cover Hydraulic Plungers	Texaco Meropa Lubricants, Texaco Crater No. 1X or 2X or Texaco Grease No. 2XG
Bearings	
Plain Sleeve Type	Texaco 629 Oil or Black Oil
Ball or Roller	Texaco Marfak 2HD or 3HD
Car Wheel Journals	Texaco 747 Oil or 629 Oil

ROLLING MILL EQUIPMENT

Mill Table Rolls and Conveyor Table Bearings	
Oil Lubricated	Texaco Regal Oils H, J, K or L
Grease Lubricated	Texaco Marfak or Grease No. 1 EP
Conveyor Table Gears	
Open	Texaco Crater No. 2X, 5X or 10X
Enclosed	Texaco Meropa Lubricants, Texaco Regal Oil J or Texaco Crater No. 00
Main Motor Drive Bearings	Texaco Regal Oil B (R&O) or C (R&O)
Main Reduction Gear Drives and Pinion Housings	
Enclosed Gears	
Main Reduction Drives	Texaco Regal Oils H, J, K or L; or Texaco Meropa Lubricants
Pinion Stands	Texaco Meropa Lubricants
Open Gears (Lubricant applied hot)	Texaco Crater No. 2X or No. 5X
Plain Bearings	
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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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THE STRIP STEEL MILL

STRIP steel became a major product of the iron and steel industry when the automotive industry popularized highway transportation. Mass production of automobile bodies, truck cabs and other parts which are shaped under pressure, required steel in strips or sheets, rolled to accurate gauge, and cut to specific widths and lengths. Strip steel was the answer.

At first, strip steel rolling was a relatively leisurely process, the mills rolling continuously in one direction producing around 300 feet of steel per minute. Through the ensuing years which preceded the latest war-time requirements, the procedure changed radically. Over a period of scarcely ten years the rate of production was stepped up to around 2300 feet per minute; hot strip rolling was perfected; reversing mills were installed; then the modern 4-high tandem cold reduction stands, the temper pass mills, and more recently, specialized machinery such as the Sendzimir mill. Today the industry is preparing to produce at a rate approaching 5000 feet per minute. This means tens of thousands of miles of strip steel in a working day for the entire steel industry.

Post war requirements are causing this fantastic rate of production, also prompting changes in mill design and operation making lubrication even more important than ever. Higher rolling speeds meant more work for the lubricants, greater use of water on hot mills meant greater chance of lubricant contamination. Then the lubrication engineer in the steel mill became an important personage. Today he must be an authority on bearing materials, methods of lubrication and means for preserving the lubricating ability of oils in service.

HOT STRIP ROLLING

Hot strip rolling starts with the slab which has been rolled from the ingot at the slabbing or blooming mill. The slab is charged into the rear end of a slab re-heating furnace and discharged at the front onto the furnace table. From here it goes to the roughing stands. The first is a 2-high scale breaker stand. Then the slab goes through four 4-high roughing stands each of which is usually equipped with vertical as well as horizontal rolls. These are known as universal roughing stands. If the vertical rolls are installed on separate units they are termed vertical edger stands. As the steel goes through the roughing stands a considerable volume of water at high pressure is blown over the surface to wash off scale.

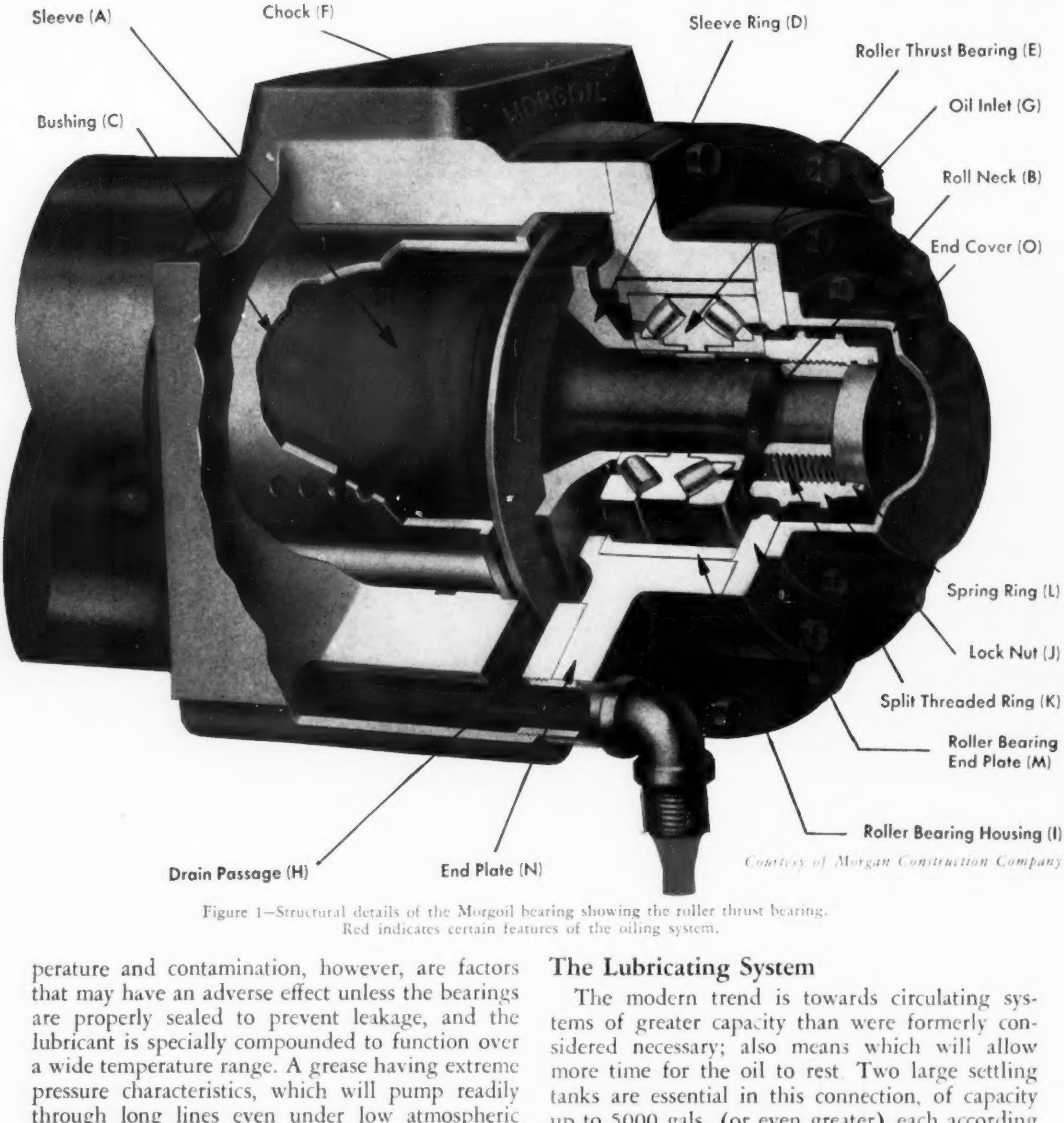
From the roughing stands the strip is passed to the finishing train which involves another 2-high scale breaker, then five or six 4-high finishing stands.

Lubrication

Lubricating under high temperature, high speed, water and scale-contamination conditions is a problem. It pertains particularly to the work roll bearings and back-up roll bearings, and indirectly to the screw down drives, the universal couplings, pinion stands and reduction gears, the table roll bearings and the coiler.

The Work Rolls

The roller bearings on the work rolls usually are grease lubricated by automatic pressure systems. As the load is carried by the back-up rolls, high pressure is not a factor on a work roll bearing. Tem-



Courtesy of Morgan Construction Company

Figure 1—Structural details of the Morgoil bearing showing the roller thrust bearing. Red indicates certain features of the oiling system.

perature and contamination, however, are factors that may have an adverse effect unless the bearings are properly sealed to prevent leakage, and the lubricant is specially compounded to function over a wide temperature range. A grease having extreme pressure characteristics, which will pump readily through long lines even under low atmospheric temperatures, which will seal the bearing against entry of contaminants and carry the prevailing loads without separation, is considered best for such service.

The Back-Up Rolls

These can be mounted on roller bearings, grease lubricated by the same system as the work rolls, or they can be carried in specially designed sleeve bearings and lubricated by an oil circulating system. As the back-up rolls carry most of the load the nature of the oil, its rate of circulation and temperature control, and the way it is kept free from contaminants, all affect its lubricating ability.

The Lubricating System

The modern trend is towards circulating systems of greater capacity than were formerly considered necessary; also means which will allow more time for the oil to rest. Two large settling tanks are essential in this connection, of capacity up to 5000 gals. (or even greater) each according to the number of bearings involved.

The modern speed conditions have more recently favored consideration of two oiling systems; one for the lower speed roughing stands and one for the higher speed finishing stands. This permits:

a) of better choice of oils of the right viscosity for the running speeds.

b) it facilitates the use of smaller capacity oiling systems.

c) it involves less loss of oil by contamination in case of defective seals.

d) it eliminates long piping layouts and enables generally a more simple arrangement.

Screw Down Drives

The screw down controls the space between the work rolls, and, as a result, the gauge or thickness of the strip; it is comparable to the screw-down on the old-fashioned home laundry wringer. The modern steel mill screw-down is motor driven; it is a heavy duty device designed to withstand high shock loads.

Lubrication of the screws can present a problem if the threads of the screws are not properly protected by a shock-resistant film of lubricant. These are versatile elements, however, and lend themselves either to oil or grease lubrication.

When oil is desired, a circulating system is provided which serves many or all of the screw-downs in the mill. For this type of lubrication a mild, non-corrosive grade of extreme pressure oil is widely used.

Grease lubricated screw-downs can be individually lubricated by a unit greasing system, or a centralized pressure system can be used. Here again a lubricant possessing E.P. characteristics is most reliable.

Universal Couplings

Couplings of this type are widely used in the modern strip mill rolling either hot or cold. They facilitate alignment between the rolls and the pinion stands.

Strip mill universal couplings are grease lubricated by unit pressure gun fittings. The problem in such a coupling is to keep an adequate film of lubricant between the brass, bronze or non-metallic slippers which form the bearing contacts. Load is a factor, also leakage must be considered, hence the preference for an adhesive type of grease with good load-carrying ability. Some operators favor using the same grease as is used on the work-roll bearings.

Pinion Stands and Reduction Gears

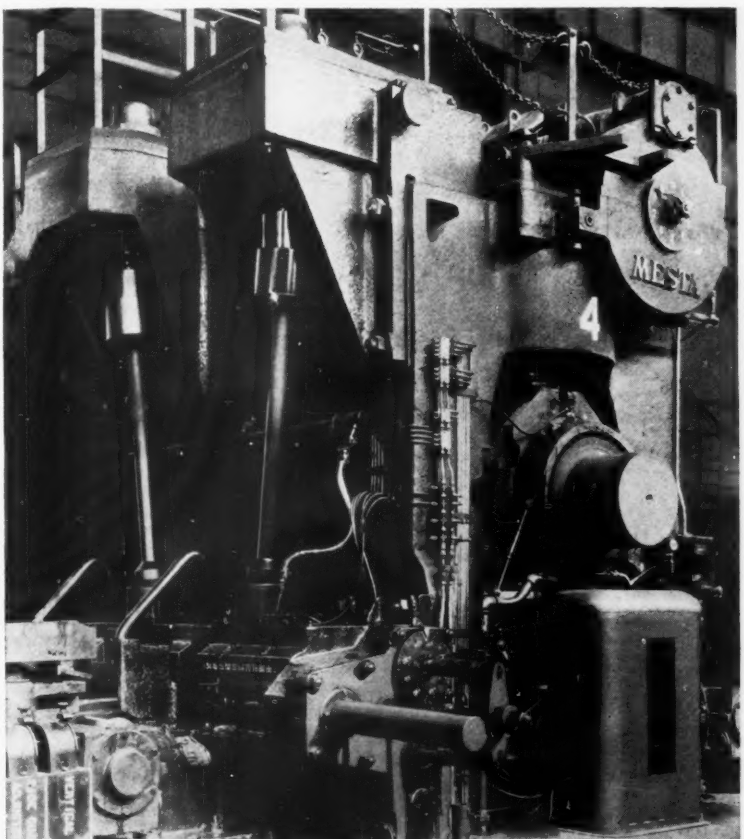
These elements which function as the main drives for the rolls are built to withstand extremely heavy loads as the impact of the steel as it enters the rolls is reacted through the roll necks directly to the pinion and gear teeth. The designer has therefore planned such units virtually as precision mechanisms. Effective lubrication enables the mill to keep them in most efficient operation.

To this end, pinion stands are completely enclosed. Two schools of thought prevail as to their lubrication:

a) Lubricating the gear teeth and bearings separately. This involves a separate oil circulating system for each stand, the circulating pumps being driven by one motor.

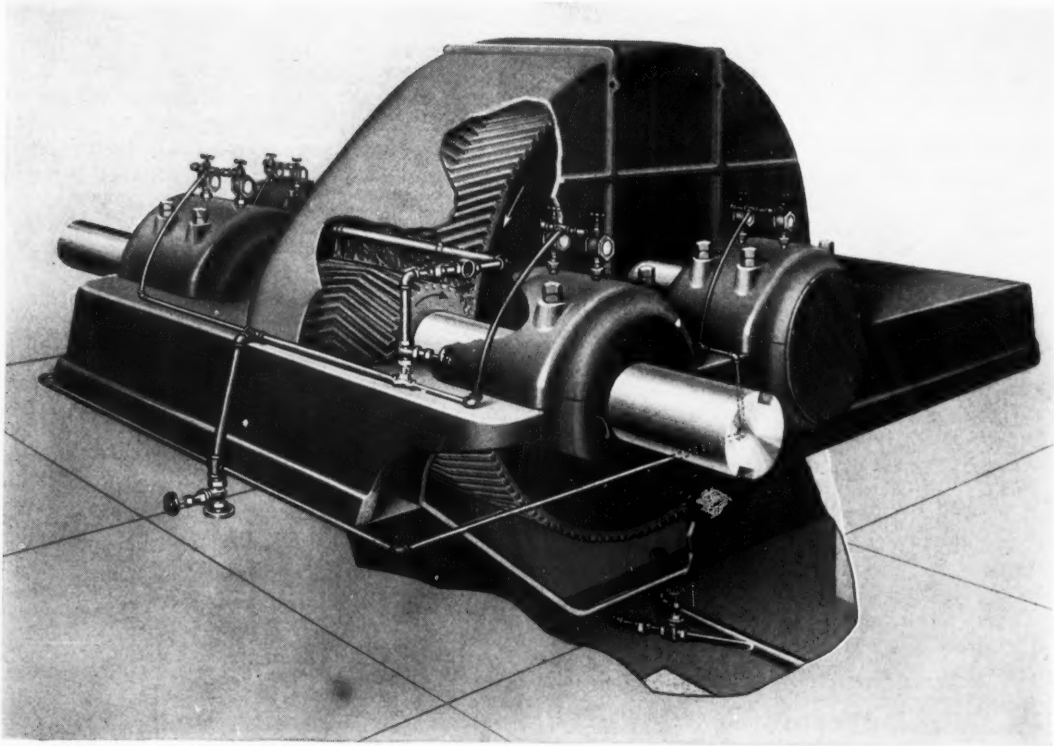
b) Using the same lubricating system for both the pinion teeth as well as the bearings.

Where two systems are used, it is possible to use a more viscous, mild, non-corrosive type of E.P. oil for the pinions, and a less viscous oil for the bearings. When the oil serves both pinions and bearings, the lubricating engineer must seek a "happy medium" and use an E.P. lubricant light



Courtesy of The Farval Corporation

Figure 2—A Mesta roughing stand showing details of the Farval centralized system of grease lubrication. Note the compact valve arrangement.



Courtesy of S. F. Bowser and Co., Inc.

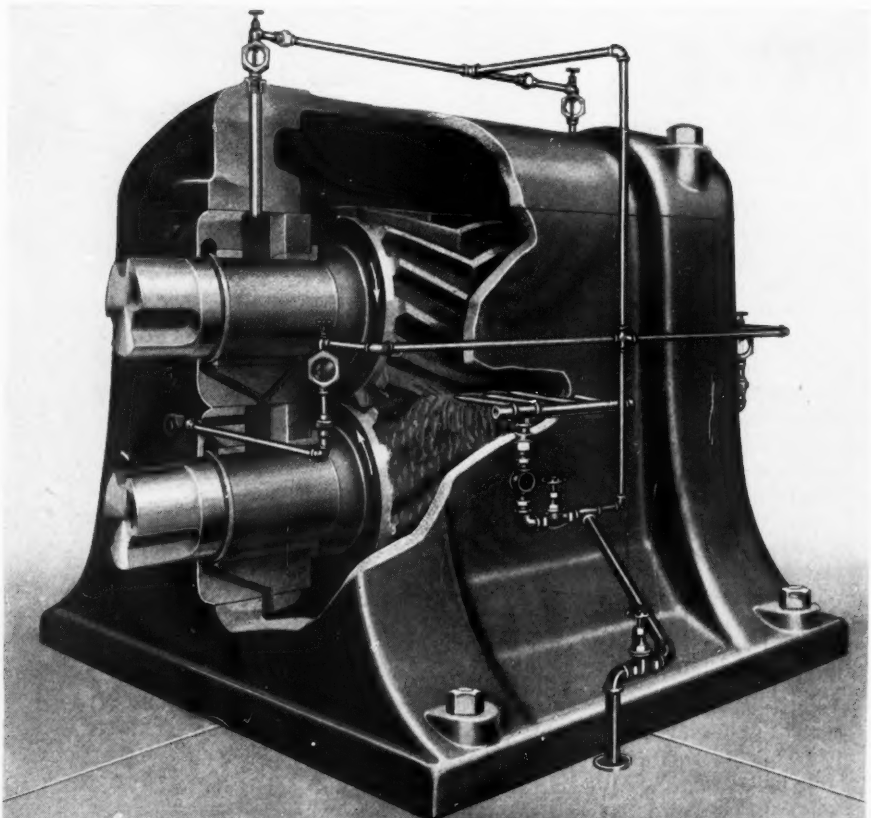


Figure 3 — (Above) Typical reduction gear drive installation showing method of lubricating gear teeth and bearings.

(To the right) Method of lubricating gear teeth and bearings of pinion stands.

enough for the bearings but still able to protect the gears.

The gears and bearings of reduction gear drives are normally splash lubricated, with a mild non-corrosive E.P. oil ranging in viscosity from 900 to 2400 seconds at 100° F.

Table Roll Bearings

Strip steel, as it passes from stand to stand is handled by table rolls; the bearings for these rolls are generally roller type. Most mills prefer the same grease as is used on their work roll bearings, in order to keep the number of lubricants at a minimum, applying same by a centralized pressure greasing system. This may be a unit system, although smaller sections of table rolls between stands can be lubricated from the same system as the work roll bearings.

The lubricating conditions can be quite severe on table roll bearings as, for example, on the run-out table to the cooler where a flood of water is applied to the strip for cooling. This can cause grease contamination. Heat can be a factor on sections where water spray is absent, or when the strip lies on rolls for some time without moving should a "cobble" have occurred. For this reason, an all-purpose grease capable of standing water and heat is desirable. E.P. characteristics are not necessary, yet some mills use the same E.P. grease as is used on their work roll bearings to reduce the number of lubricants being handled.

Table Roll Drive Shafts

The shaft bearings for the table roll mitre gears are normally grease lubricated with the same grease as used on the table roll bearings. The gears are splash lubricated with a mild, non-corrosive E.P. gear oil or the same straight mineral oil as is used on the back-up rolls.

The Coiler or Reel

The coiler (or reel as it is called in cold mills) automatically rolls or coils the strip after it has passed through the last finishing stand. The coiler or reel comprises a rotating member surrounded by segments containing two guide rolls each. These rolls are carried on roller bearings provided for grease lubrication. Protection of these bearings is important due to the heat which is still retained by the strip, and the water which some times deluges the coil during winding. The problem, however, is not so much to find a suitable grease, as to protect the distributing pipes of the pressure lubrication system, against the flapping end of the strip as each coil completes its winding and is discharged from the machine. A good quality lime soap grease containing about a 1100/1200 S.U.V.* oil will perform satisfactorily if fed through delivery pipes which can be more or less moulded to the end surfaces of the roll segments and thereby kept away from the end of the coil; guards are not entirely dependable as they are too easily knocked off.

*Seconds Saybolt Universal Viscosity at 100° Fahr.

COLD REDUCTION

Cold reduction of strip steel involves the strip after it has passed through a number of previous reductions and been coiled. In the cold reduction department it is passed through raw coil pickling lines, uncoiled, run through a hot acid bath, then a water washing bath, dried by hot air and recoiled.

The bearings on the uncoiler and feed rolls are exposed to heat, acid and water. Also some contamination of the bearing lubricant with palm oil may occur. Palm oil or a light straight mineral oil is used to protect the surface of the strip as it leaves the pickling stage. An uncoiler in a cold reduction mill feeds the strip through three, four or five stands of the 4-high tandem cold reduction mills. The work rolls and back-up rolls on these mills are similar to those used on hot strip mills and lubricated in like manner.

Roll Oils May Contaminate Lubricants

The type of roll oil which is ordinarily used depends on the gauge of the strip. Heavier steels can be rolled with a 75 to 100 second (Saybolt Universal Viscosity at 100° F.) paraffin base oil; on lighter steels soluble oil-water mixtures, palm oil or water plus palm oil are used.

Straight mineral roll oils in contact with bearing lubricants tend to thin them down; soluble oils or palm oil introduce a fatty oil which, when mixed with the bearing circulating oil, promotes permanent emulsions. Cold reduction mills however, are well-designed to retard such contamination; also there are no high pressure hydraulic sprays required since there is no scale problem. The water conditions, therefore, are not as bad as in a hot mill.

Other Machinery in Cold Reduction

Screwdowns, pinion stands, reduction gears, coilers and the other machinery required for handling the strip is quite similar to the units already discussed under Hot Strip Mills and lubricated accordingly.

Temper Pass Mills

Temper pass mills have a roll set-up similar to that in a cold reduction mill; i.e., roller bearings on the work rolls, and roller or sleeve bearings on the back-up rolls.

Lubrication of a temper pass mill only involves the problem of heat and pressure. No water or roll oil is involved to cause lubricant contamination. Surface contamination is a different matter. The surface of the strip passing through a temper pass mill must be kept free from oil or grease stains, so lubricant leakage or throwing must be prevented. There is no provision to remove such stains.

THE LUBRICANTS TO ATTAIN LUBRICATION

The primary lubricants required for strip steel mill machinery are:

— the circulating oil

— anti-friction bearing greases and

— gear lubricant

Circulating Oil

Must be a very highly refined product made from most carefully selected stock. The exacting demands imposed by the operating conditions require that in steel mill service a circulating oil must function without possibility of breakdown and formation of damaging sludge and carbon deposits. Resistance to oxidation (high chemical stability) and ability to separate rapidly from water are essential in this type of service.

The Grease

The tendency in strip steel service is towards a multi-purpose type of grease capable of standing heat, water and contamination. Extreme Pressure properties are necessary to meet the loads and back-up roll conditions. E.P. characteristics also lessen the tendency towards pitting of bearings on hot strip stands. Resistance to water-washing is required when the grease is used on work roll bearings. Good pumpability is essential as the grease may often have to be pumped through lengthy distributing lines. Maximum stability assures good resistance to oxidation and satisfactory protection of highly polished bearing surfaces, also freedom from separation under the severe churning action encountered in roller bearings.

Gear Lubrication

In steel mill service the pressures usually encountered will be high; they may be especially severe on gear tooth surfaces where a relatively small area of contact prevails. This has favored a decided trend toward the mild Extreme Pressure type of non-corrosive gear lubricant. The load-carrying ability is obtained by blending high quality mineral oils with carefully selected lead soaps and suitable E.P. additives in such a manner as to produce compounds of pronounced stability and adhesiveness, which free themselves readily of water. As shock loads are frequently encountered, the gear lubricant must not only be viscous enough to cushion these hammer-like blows on the teeth, but also adhesive enough to resist being squeezed from the tooth contact areas.

FACILITIES TO IMPROVE LUBRICATION

An Effective Circulating System

Capable of circulating a sufficient volume of oil, and of such capacity that a suitable rest period for the return oil is practicable.

Suitable Provisions for Temperature Control

Location of steam or cooling water coils is most important. If within the settling tank or base of a pinion stand, preferably they should be on the side instead of on the bottom to avoid water contamination in case of leakage, or "cooking" the oil when steam heating is required. Better still, install heating coils outside the tank.

Filters and Centrifuges

To assure proper purification of oil by removal of all foreign matter. Magnetic filters remove finely divided iron. Bag filters and centrifuges take care of water, dirt and other non-lubricating materials. Clay type filters are best suited where water is absent; will not operate on oils containing water as the latter tends to "mud" or pack the clay.

Air Vents

To relieve back pressure on the lubricant. Unless an oil can expand freely with increase in temperature, the back pressure may cause seals or bearing housings to leak. Small return lines can cause back pressure to build up. Grease lubricated anti-friction bearings also should be vented to protect the seals when grease is applied under pressure. Reduction gear housings should be vented to keep the temperatures down.

Rust Proofing Circulating Tanks

A beneficial procedure, especially on the interior surfaces of the top, and sides above the oil level. This keeps rust particles from forming and flaking off to contaminate the oil.

Dual Settling Tanks

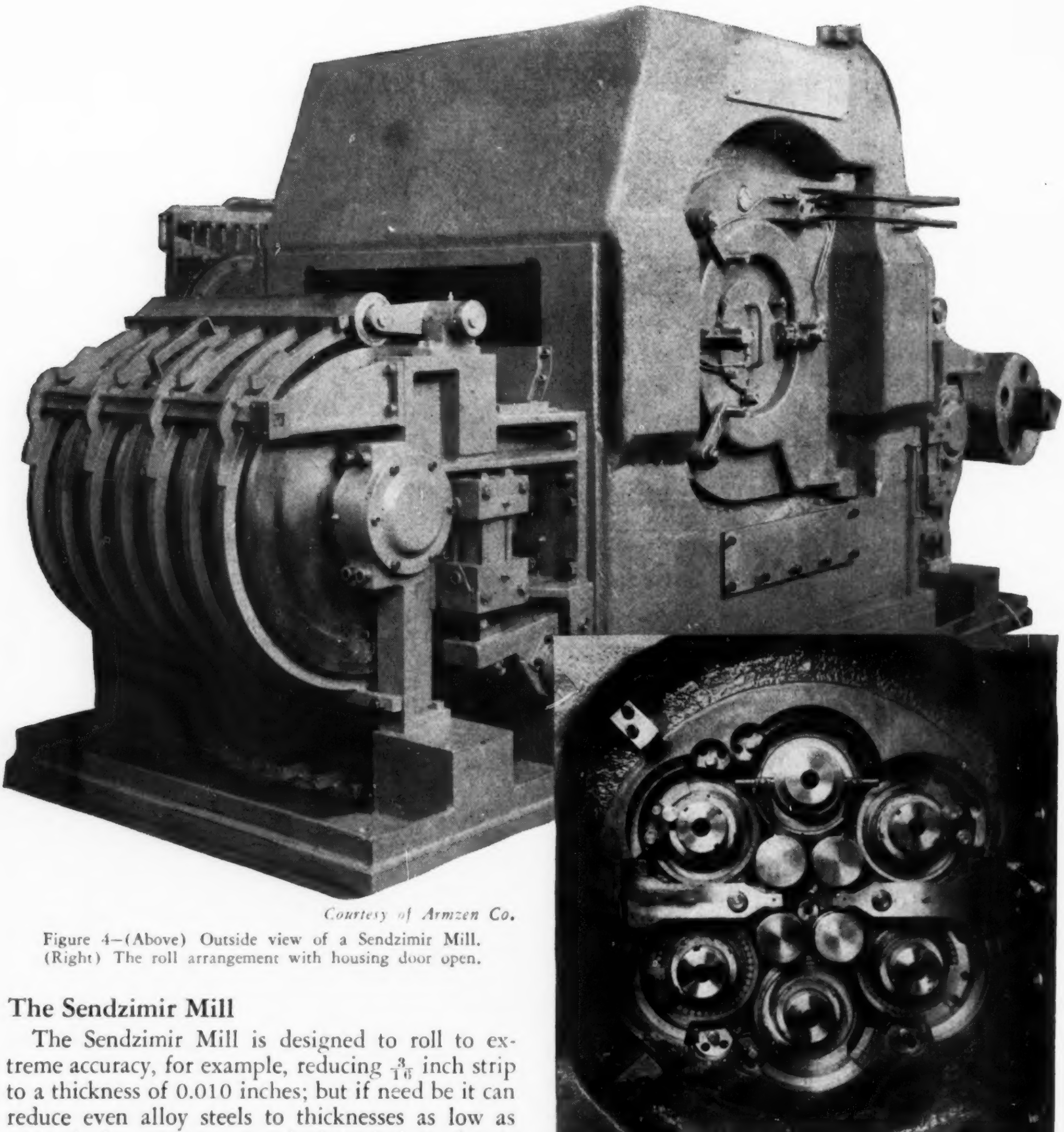
A 2-tank system enables one to always be available for use when the other is to be cleaned. Batch cleaning of the oil, along with tank cleaning at regular intervals, insures longer oil life and prevents foreign matter from circulating.

Cleaning Procedure

Frequency depends upon extent of oil contamination. Cleaning of a settling tank removes iron soaps and other substances which serve as catalysts to promote sludging.

Checking for Moisture Content

Should be done daily. Water content in a circulating oil may build up fast if seals are damaged. Removal of water promptly facilitates breaking of potential emulsions. Water legs are helpful in keeping small amounts of water out of settling tanks, or indicating the presence of water.



Courtesy of Armzen Co.

Figure 4—(Above) Outside view of a Sendzimir Mill. (Right) The roll arrangement with housing door open.

The Sendzimir Mill

The Sendzimir Mill is designed to roll to extreme accuracy, for example, reducing $\frac{3}{16}$ inch strip to a thickness of 0.010 inches; but if need be it can reduce even alloy steels to thicknesses as low as 0.001 inches without anneal. A typical Sendzimir Mill involves four driving rolls and six supporting rolls. Each of the latter is essentially a line of antifriction bearings, one after the other, so located that the work rolls are completely supported throughout their entire length. The outer bearings are mounted on eccentrics in staggered saddles so the distance between the work rolls can be accurately adjusted. The final backing is the extremely rigid steel housing.

In choosing an oil for this service four requirements are involved, i.e.,

1. It must lubricate the roll bearings.
2. It must act as a coolant.
3. It must be easily removed from the strip by the rubber scraper. If excessive oil remains, there is, on some metals, a tendency of the strip to telescope off the wind-up roll.
4. It must not "fog" to excess, especially at high speeds. Fogging may be due to agitation, temperature, the sudden release of pressure on the oil as it comes out on the strip from the rolls, or a combination of any of the above.

Filtered oil is first introduced under pressure into the hollow eccentric shafts, so that an even quantity of oil passes through each bearing, escaping through its seal, and cascades over the rolls, at

the rate of 9 gallons per minute on a 15″ mill, and 125 gallons per minute on a 39″ mill. The oil from the bottom of the housing drains back to the reservoir, from which it is circulated by a suitable pump. Much of the oil gets on the strip before the latter goes through the rolls, a desirable feature from a cooling standpoint. The lower supporting rolls are submerged in oil, the overflow going out of slits located in the housing a little below the level of the work rolls. The oil is filtered before it is recycled to the work rolls.

CENTRALIZED LUBRICATION

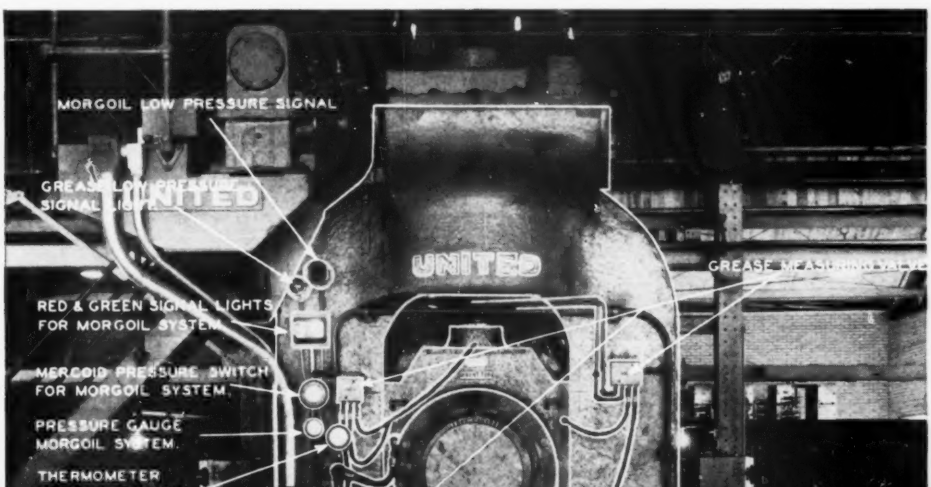
Centralized pressure lubrication involves either grease or oil, according to the design of the lubricating system. Where oil is used, circulation normally prevails, the oil being re-used over and over again. Suitable oil purification equipment is incorporated in the circulating system.

Grease however, is used but once. Since purification of grease is not practicable, a fresh charge is delivered whenever the pressure lubricating system goes into operation. There are advantages to any such means of lubrication: e.g.,

1. Positive delivery of lubricant insures maintenance of a sufficient film between the bearing surfaces.
2. Non-lubricating foreign matter is excluded.
3. Equipment can be lubricated while in operation.
4. Hazard in handling or filling of lubricating equipment is reduced.
5. Economy of lubricants.

PRESSURE GREASE LUBRICATION

The adaptability of centralized control was first studied with respect to greases; it was pioneered by the iron and steel industry. When roll neck bearings, table rolls, and the wide variety of other heavy duty bearings were largely exposed, heavy greases were used; they were best able to remain adjacent to the parts to be lubricated with consequently less loss. At best, however, this type of lubrication was inadequate. Furthermore, loss of lubricant meant dripping and introduced a personal hazard which was contrary to all ideals of safety. As steel mill rolling machinery was improved and designed to run at higher speeds, a number of ways were developed to enable control



Courtesy of United Engineering and Foundry Co.

Figure 5—End view of a United mill, showing details of the lubricating systems serving the grease-lubricated roller bearings on the work rolls, and the oil lubricated Morgoil back-up roll bearings.

of greases and their delivery to the various points of application. In all, power in some form or other prevails. Control at each point to be lubricated is attained by positive piston displacement types of metering valves. In such a system either one or two lubricant supply lines can be connected to each valve according to the type of system. In the steel mill, dual lines are sometimes employed, each serving alternately to load the respective valves periodically with the right amount of lubricant, and also to discharge this to the bearings. Certain of these systems are designed to eliminate the necessity for springs, check valves or restricted port openings. Due to the fact that they operate under high pressure, any air in the system is soon exhausted by the measuring valves to assure positive delivery of a measured charge of lubricant.

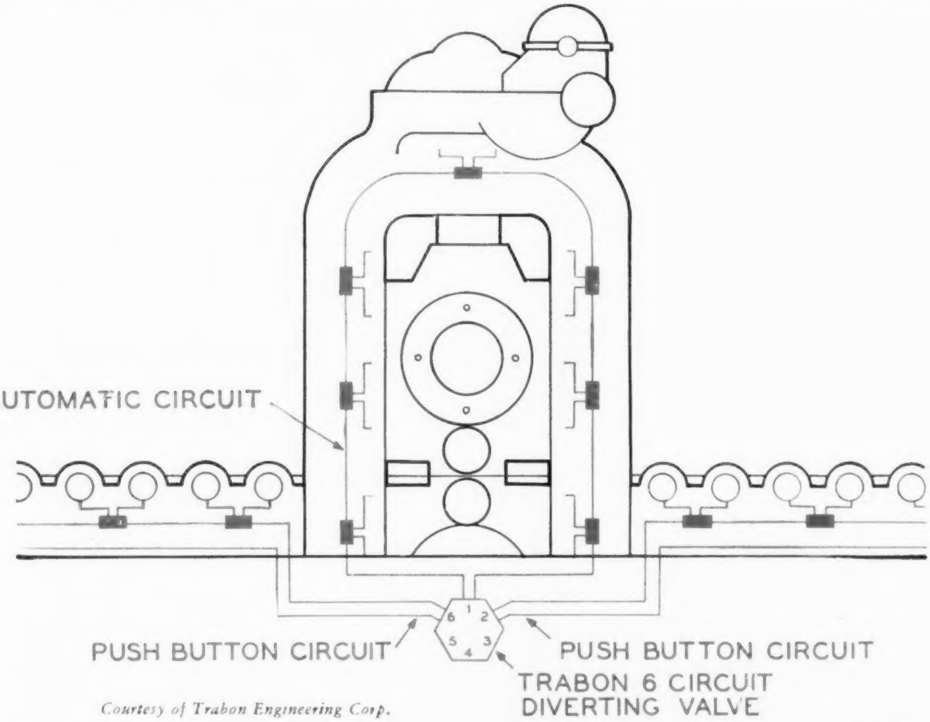
As centralized pressure grease lubrication gained in popularity in the steel industry, improvement in bearing closure with marked extension of the use of roller bearings and the use of lighter bodied greases also developed. Both increase operating economies, the former from the viewpoint of reducing leakage and improving working conditions, the latter by reducing the amount of power required for mill operation.

Collective lubrication through manifold equipment as practiced today, assures of positive and uniform distribution of the lubricant. Furthermore, direct power systems are well suited to service where comparatively high application pressures are desirable. Positive and complete cleaning of bearing grooves and clearance spaces at periodic intervals is of primary importance, especially where conditions of operation may result in accumulation of dust, dirt or other non-lubricating foreign matter.

Pressure Must Be Used Judiciously

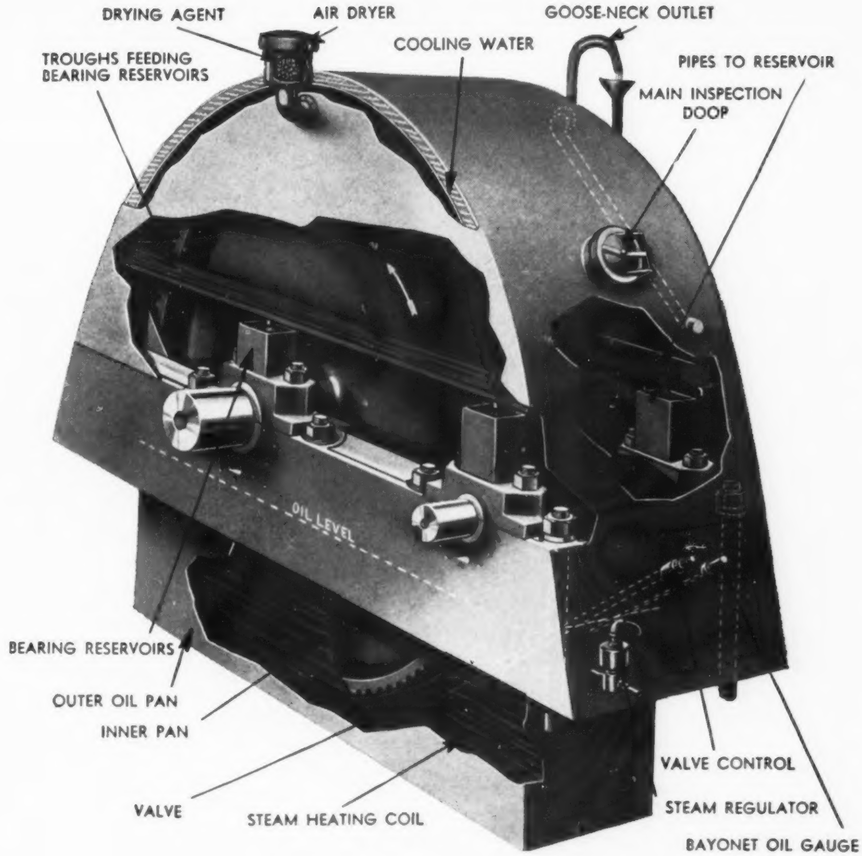
The value of pressure in forcing out old grease and dirt from certain types of bearings has been definitely proved. Judgment is necessary, however, in determining when this has been completely accomplished and when to shut off the pressure and cease forcing in new grease. If properly done, pressure grease lubrication is decidedly economical. If the operator is careless, however, unobservant, or continues to apply lubricant beyond the necessary extent, grease will not only be wasted but also a sloppy condition around bearings may develop.

The amount of grease delivered to a roller bearing can be controlled by judicious installation of a suitable vent in the upper part of the housing which enables efflux of grease after a certain amount has



Courtesy of Trabon Engineering Corp.

Figure 6—Showing a Trabon Automatic circuit feeding the mill bearings, with two push button circuits which can be operated at the discretion of the operator, to feed the table roll bearings. The Trabon diverting valve can handle up to six circuits in this fashion.



Courtesy of The Falk Corporation

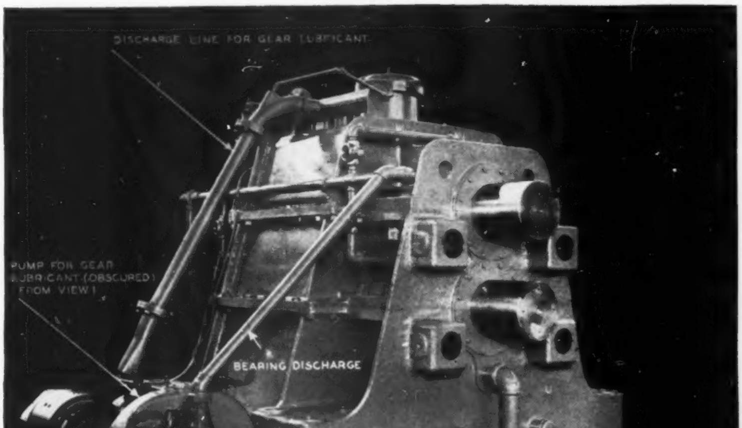


Figure 7—(Above) Cutaway view of a Falk pinion drive gear unit showing the controlled system of splash lubrication. (Right) Exterior view of a pinion stand and lubricating unit with important parts indicated.

been charged. Concentration of pressure gun fittings at a central panel or point of control will also aid in reducing hazard and the labor essential to lubrication.

OIL CIRCULATION

Continuous circulation of comparatively fluid oils became practicable with the extension of oil-tight housings to certain types of steel mill gears, and the design of lubricating systems to serve both gears and bearings with the same oil. Installations of this type are comparable to the reduction-geared steam turbine, involving operating conditions which require oils of similar characteristics, though usually of somewhat heavier body, ranging in viscosity from around 800 to 2500 secs. Saybolt at 100° F.

Gear design influenced this development — improvement in tooth cutting especially with respect to bevel units having been studied in the interest of obtaining higher speeds with reduction in wear and noise. Circulation of fluid oils under uniform pressure conditions was found to be in line with these requirements, and helpful in reducing operating temperatures through the cooling effect of an excess of fresh cool oil. The sleeve-type, flood lubricated bearing was also a contributing factor; its development not only focused attention upon the matter of bearing sealing but also upon the necessity for oils which would be chemically stable and resistant to emulsification and sludge formation; this is very important when the bearing is not sealed effectually against entry of water. With the advent of higher speed mills increase in the amount of water used on the stock increases the chance of water leakage into the bearing.

Obviously the viscosity is the most important physical characteristic, for it is subject to change with change in temperature and contingent upon change in speed. The temperature range in the modern steel mill circulating system is confined within a relatively narrow range say between 90 and 130 degrees Fahr., with a fair average bearing temperature of around 105 degrees. The viscosity of the oil should be studied at the prevailing operating or bearing temperature.

In turn, where practicable, the viscosity should vary inversely as the speed. So, in a variable speed continuous mill where the speed of roughing is slow, heavier oil is required than would be needed for the bearings on the finishing end which are subjected to higher roll neck speeds.

High quality oils should always be used unless heat has developed or leakage occurs to such an extent as to warrant the use of secondary oils.

Planning the System

The extent to which entirely automatic operation should be approached has been widely discussed. Certain authorities feel that the unit idea whereby each mill is designed as an individually lubricated unit, will reduce the possibility of extended difficulties should faulty circulation develop anywhere in the system.

Force-feed lubrication involving full pressure affords a most efficient method of bearing and gear lubrication; it is applicable with equal facility to the sleeve-type roll neck bearing or the oil tight gear housing. By circulating, clean oil under uniform pressures, from a central reservoir, to bearings and gears to provide proper lubrication and to remove heat from the friction surfaces, the life of these parts is materially increased, especially under over-load and speed-up conditions.

With the full pressure system the supply pump delivers oil at a predetermined pressure from the settling tank to a pressure tank in which an air cushion is provided at the top. Such systems call for two pumps, one of which serves as a spare. This latter cuts in automatically, by means of electrically operated pressure switches when the pressure in the pressure tank drops below a predetermined minimum should failure of the operating pump occur or whenever the desired pressure cannot be maintained. If both pumps fail or are unable to maintain sufficient pressure another pressure switch, which is set just below minimum required operating pressure sets off an alarm.

Expansion of the air cushion in the pressure tank forces the oil through the main supply line and the numerous branch lines; these are equipped with orifice plates or valves to provide each bearing or gear unit with its proper share of lubricant. Frequently each of the various points of lubrication are equipped with a pressure switch and light signal to warn the operator should the oil flow be interrupted. The return oil from the gears or bearings flows back to the settling tank by gravity for reconditioning and recirculation. Full pressure lubrication is highly flexible and widely used on enclosed steel mill machinery.

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TEXACO LUBRICATION RECOMMENDATIONS FOR STEEL MILL EQUIPMENT

Continued from inside front cover

ROLLING MILL EQUIPMENT (Cont.)

Main Reduction Gear Drives and Pinion Housings (continued)	
Plain Bearings	
Grease Lubricated	Texaco Grease No. 1 EP, No. 2 EP or Texaco Texmill Grease No. 1 or No. 2 or Texaco H Grease No. 1 or No. 2
Roller Bearings	
Automatic Grease System	Texaco Grease No. 1 EP or No. 2 EP
Roll Stands	
Screws and Screw-down drive	Texaco Meropa Lubricants
Roll Neck Bearings	
Plain (Hand packed)	Texaco Texmill Grease No. 7
Plain (Grease system)	Texaco Grease No. 1 EP or No. 2 EP; or Texaco H Grease No. 1 or No. 2; or Texaco Texmill Grease No. 1 or No. 2
(Oil circulated)	Texaco Regal Oil H, J, K or L
Roller (Grease System)	Texaco Grease No. 1 EP or No. 2 EP
Edger Roll drives	Texaco Meropa Lubricants
Coiler	Texaco H Grease No. 1 or Texaco Grease No. 1 EP
Universal Couplings	Texaco Grease No. 2 XG Texaco Grease No. 904 or Texaco Grease No. 1 EP

ACCESSORY EQUIPMENT

Hot-Bed Skids and Guides	Texaco 629 Oil or No. 510 Oil
Hot-Bed Wire Ropes	Texaco Crater No. 0 or No. 00
Over-head Cranes	
Open Gears	Texaco Crater No. 0 or No. 1
Oil Bearings	Texaco Altair or 747 Oil
Grease Bearings (plain)	Texaco H Grease No. 1 or No. 2; or Texaco Star Grease No. 1 or No. 2
Track Wheels (Roller Bearings)	Texaco Marfak or Texaco Grease No. 1 EP or No. 2 EP
Track Wheels (Plain Bearings)	Texaco Wool Yarn Elastic Grease
Cables	Texaco Crater A or Texaco Vega Grease No. 3
Hot and Cold Saw Bearings (High Speed)	
Ring Oiled or Circulating System	Texaco Regal Oil B (R&O)
Grease Bearings	
Plain or Roller	Texaco Regal Starfak or Texaco Grease No. 1 EP or No. 2 EP
Hydraulic Accumulator	
Plungers	Texaco Grease No. 2 XG Texaco Meropa Lubricant 5 Texaco Pinnacle Cylinder Oil